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# Gender Differences in Risk Factor Profiles and Predictors of Poor Outcomes Among Acute Stroke Patients: A Pilot Study from Egypt

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# GENDER DIFFERENCES IN RISK FACTOR PROFILES AND PREDICTORS OF POOR OUTCOMES AMONG ACUTE STROKE PATIENTS: A PILOT STUDY FROM EGYPT

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## ABSTRACT

**Background and objective:**

Stroke remains a leading cause of mortality and long-term disability worldwide, with significant socioeconomic implications. This study aimed to investigate gender-based differences in acute stroke patients regarding baseline characteristics, clinical presentation, and predictors of poor outcome Among Egyptian population.

**Methods:**

We prospectively recruited 116 acute stroke patients admitted to the stroke unit at Cairo University Hospitals from January 2020 to June 2020. Detailed data on demographics, clinical characteristics, diagnostic workup, hospital course, and functional outcomes were collected. Poor outcome was defined as a modified Rankin Scale (mRS) ≥ 3 at discharge. Data were analyzed using SPSS version 28 (IBM Corp., Armonk, NY, USA).

**Results:**

The study included 60 males (51.7%) and 56 females (48.3%) with a median age of 62 years. Atrial fibrillation (32.1% vs 15%, p = 0.029) and obesity (80.3% vs 66.7%, p = 0.010) were more common in females, while smoking history was more common in males (70% vs 7.1%, p < 0.001). Females had higher levels of total cholesterol (median 238 vs 189 mg/dL, p = 0.007) and triglycerides (median 160 vs 141 mg/dL, p = 0.026). Using regression analysis, dysphagia remained an independent predictor of poor outcome in both females (OR : 23.4, 95% CI : 2.521-217.2, p=0.006) and males (OR : 15.769, 95% CI : 1.686-147.509, p=0.016).

**Conclusion:**

This pilot study highlights important gender differences in stroke charachteristics and emphasizes the need for a wide-scale stroke registry in Egypt. The strong association between dysphagia and poor outcomes in both genders highlights the importance of early dysphagia screening and management in acute stroke care.

**Keywords:** Stroke, Stroke outcomes, Stroke characteristics, Egypt

## INTRODUCTION

Stroke is a leading cause of death and long-term disability worldwide. There are biological differences between males and females that may impact stroke risk factors, clinical presentation, and stroke outcomes. However, two-thirds of clinical stroke research is mostly based on men.[1] This research gap is costing lives. Understanding gender-based differences in stroke characteristics and outcomes is crucial for developing targeted prevention strategies and optimizing patient care.

Previous studies have suggested that women and men may differ in terms of stroke risk factors, clinical presentation, and outcomes.[2,3] However, results have been inconsistent among different populations, highlighting the need for region-specific data. Sociocultural factors such as education, social status, and financial status can influence gender-based differences in stroke characteristics and outcomes. Social and gender norms may affect women's access to healthcare, education, and economic opportunities, potentially impacting their overall health and stroke risk.

Traditional gender roles often assign women primary caregiving responsibilities, which can lead to delayed recognition of stroke symptoms and delayed seeking of medical attention. The "Yentl syndrome" was used to describe the underdiagnosis of ischemic heart disease among women.[4] This concept has been extended to stroke, highlighting the tendency for delayed stroke diagnosis and treatment among women. Few investigators have addressed gender-based differences in stroke characteristics and outcomes among Egypt and other Middle Eastern countries.[5-10] Egypt shares the same heavy burden of stroke like other developing countries.[11] In Egypt, World Health Organization estimates indicate that stroke is the third leading cause of death after ischemic heart disease and COVID-19.[12]

The aim of this pilot study was to investigate gender-based differences in acute stroke patients admitted to the stroke unit at Cairo University Hospitals (Egypt). We investigated differences in baseline characteristics, clinical presentation, and predictors of poor outcomes between male and female stroke patients.

## METHODS

In this prospective cross-sectional pilot study, we recruited acute stroke patients admitted to the stroke unit at Cairo University Hospitals from January 2020 to June 2020. Adults aged over 18 years with confirmed acute stroke, either ischemic or hemorrhagic, were included. We used the American Heart Association/American Stroke Association (AHA/ASA) definition of acute stroke.[13] We excluded patients with subarachnoid hemorrhage, and those who refused hospital admission or were discharged against medical advice.

The study was conducted in accordance with the Declaration of Helsinki and approved by the Research Ethics Committee of Cairo University (protocol code: MS-459-2020 and date of approval: 12 February 2021). All participants or their legal representatives provided informed consent.

Clinical data were treated in accordance with the local hospital rules. All clinical data analyzed were collected as part of routine diagnosis and treatment. We identified demographic, clinical, radiological, and laboratory data including vascular risk factors, qualifying events, other non-qualifying events, the National Institutes of Health Stroke Scale (NIHSS), brain parenchymal imaging, vascular imaging, acute thrombolysis, length of hospital stay, and modified Rankin Scale (mRS) at discharge. The stroke subtype was identified according to the Oxfordshire Community Stroke Project (OCSP) classification system, as Total Anterior Circulation Stroke (TACS), Partial Anterior Circulation Stroke (PACS), Posterior Circulation Stroke (POCS), or Lacunar Stroke (LACS).[14] Presumed stroke etiology was identified using the Trial of ORG 10172 in Acute Stroke (TOAST) classification, as large-artery atherosclerosis, cardioembolic, small vessel disease, stroke of other determined etiology, or stroke of cryptogenic/other non-determined etiology.[15] Follow-up mRS after 90 days was obtained either at the outpatient clinic or by telephone contact.

Patients were classified according to gender into two groups to detect gender-based differences in baseline, clinical, and predictors of poor outcomes. Poor outcome was defined in this study as functional independence with mRS $\geq 3$ at discharge.

Data were analyzed using SPSS version 28 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as means, standard deviations, medians, and interquartile ranges for continuous variables, and frequencies and percentages for categorical variables. The Mann-Whitney test was used for comparing quantitative variables, and the Chi-square test (or Fisher's exact test when the expected frequency was less than 5) was used for categorical data. Logistic regression analysis was performed to identify independent predictors of poor outcomes. Variables with $p < 0.1$ in univariate analysis were included in the multivariate model. P-values less than 0.05 were considered statistically significant.

## RESULTS

The study included 116 acute stroke patients (60/116 males, 51.7%; 56/116 females, 48.3%). The median age was 62 years, with a range from 32 to 88 years. The qualifying event was an ischemic stroke in 76.7% (89/116), and a hemorrhagic stroke in 23.3% (27/116).

### Gender-based differences in baseline and clinical characteristics:

Comparison between males and females regarding baseline and clinical characteristics was done (Table I). The median age was 60.50 years among males, and 62.50 years among females, with no statistically

significant difference between both genders (p = 1). Atrial fibrillation was significantly more common in females (females: 32.1% vs males: 15%, p = 0.029). Obesity (defined as Body Mass Index > 30 kg/m2) was more prevalent in females (females: 80.3% vs males: 66.7%, p = 0.010). Smoking history was more common in males (70% vs 7.1%, p < 0.001). Females had higher levels of total cholesterol (median 238 vs 189 mg/dL, p = 0.007) and triglycerides (median 160 vs 141 mg/dL, p = 0.026). Males had higher uric acid levels (median 8 vs 7.1 mg/dL, p = 0.041). Hypertension and metabolic syndrome were more common in females, but without reaching statistical significance (males: 58.3% vs females: 75%, p = 0.058; and males: 26.7% vs females: 42.9%, p= 0.067, respectively). Also, length of hospital stay was longer in females without reaching statistical significance (median for females: 13 days, males: 10.5 days; p = 0.088).

**Table 1: Comparison between males and females regarding baseline and clinical characteristics.**

| Characteristic | | Males (n=60) 51.70% | | Females (n=56) 48.30% | | P value |
|---|---|---|---|---|---|---|
| Age, median (range) | | 60.50 (32-83) | | 62.50 (38-88) | | 1 |
| Hypertension, no. (%) | | 35 | 58.30% | 42 | 75.00% | 0.058 |
| Diabetes mellitus, no. (%) | | 21 | 35.00% | 26 | 46.40% | 0.210 |
| Coronary artery disease, no. (%) | | 19 | 31.70% | 16 | 28.60% | 0.717 |
| AF, no. (%) | | 9 | 15.00% | 18 | 32.10% | 0.029** |
| Body Mass Index > 30 kg/m2, no. (%) | | 40 | 66.70% | 45 | 80.30% | 0.010** |
| Peripheral vascular disease, no. (%) | | 3 | 5.00% | 1 | 1.80% | 0.619 |
| Metabolic syndrome, no. (%) | | 16 | 26.70% | 24 | 42.90% | 0.067 |
| Previous stroke or previous TIA, no. (%) | | 18 | 30.00% | 16 | 28.60% | 0.866 |
| Smoking history, no. (%) | | 42 | 70.00% | 4 | 7.10% | < 0.001** |
| Migraine (classic/common) | | 1 | 1.70% | 4 | 7.10% | 0.195 |
| NIHSS admission, median (IQR) | | 12 | (7-16) | 14 | (9-17) | 0.110 |
| Time from onset to arrival (hours), median (IQR) | | 5 | (3-7) | 5 | (3-8) | 0.611 |
| Received IV or IA thrombolysis, no. (%) | | 13 | 21.7% | 20 | 35.7% | 0.203 |
| Cholesterol, median (range) | | 189 | (99-355) | 238 | (92-313) | 0.007** |
| TG, median (range) | | 141 | (27-319) | 160 | (57-303) | 0.026** |
| HbA1c, median (range) | | 5.8 | (4.2-13) | 6.4 | (4-15.7) | 0.248 |
| Uric acid, median (range) | | 8 | (3.6-13.6) | 7.1 | (3.5-13) | 0.041** |
| Presumed stroke etiology according to TOAST classification | large artery atherosclerosis, no. (%) | 20 | 45.50% | 25 | 55.60% | 0.335 |
| | cardioembolic, no. (%) | 14 | 31.80% | 13 | 28.90% | |
| | small vessel disease, no. (%) | 9 | 20.50% | 5 | 11.10% | |
| | other determined etiology, no. (%) | 0 | 0.00% | 2 | 4.40% | |
| | cryptogenic/other non-determined etiology, no. (%) | 1 | 2.30% | 0 | 0.00% | |
| Length of hospital stay in days, median (IQR) | | 10.5 | (8-15) | 13 | (9-21) | 0.088 |
| Good mRS (0-2) at discharge, no. (%) | | 6 | 10% | 7 | 12.5% | 0.158 |
| Good mRS (0-2) at 90 days follow-up, no. (%) | | 9 | 15% | 6 | 10.7% | 0.082 |

AF: Atrial Fibrillation; TIA: Transient Ischemic Attack; NIHSS: National Institutes of Health Stroke Scale; IQR: interquartile range; TOAST: Trial of ORG 10172 in Acute Stroke Treatment, mRS: modified Rankin Scale.

No statistically significant gender-based differences were observed for other risk factors such as diabetes mellitus (p= 0.210), coronary artery disease (p= 0.717), peripheral vascular disease (p= 0.619), previous stroke or transient ischemic attack (p= 0.866), family history of stroke (p=0.871), or migraine (p= 0.195). There was no significant gender-based difference regarding admission NIHSS scores (p = 0.110), time from stroke onset to hospital arrival (p= 0.611), percentage of patients receiving acute thrombolysis (p=0.203), incidence of thrombolysis-related adverse events (p= 0.330), stroke subtype according to the Oxfordshire classification (p = 0.243), and presumed stroke etiology according to the TOAST classification (p = 0.335).

There was no statistically significant gender-based difference in functional outcomes at discharge as measured by mRS (mRS ≤ 2 in females: 12.5%, males: 10%; p = 0.158). However, more males had good functional outcome at 90-day follow-up without reaching statistical significance (mRS ≤ 2 in females: 10.7%, males: 15%; p = 0.082).

Comparison between patients with poor outcomes at discharge (mRS ≥ 3), and patients with good outcomes at discharge (mRS ≤ 2) among males and females regarding baseline and clinical characteristics was done (Table 2). Stepwise regression analysis was performed to detect independent predictors of poor outcome among males and females separately.

For females, the univariate analysis showed older age (median 64 vs 47years, p = 0.016), higher admission NIHSS (median 15 vs 7, p = 0.001), and the presence of dysphagia (79% vs 14.3%, p = 0.001) were the predictors of poor outcomes. For males, the univariate analysis showed higher admission NIHSS (median 13 vs 6, p = 0.003), increased length of hospital stay (median 11 vs 7.5 days, p = 0.04), and the presence of dysphagia (75.9% vs 16.7%, p = 0.008) were the predictors of poor outcomes.

After adjusting for age, admission NIHSS, and length of hospital stay in multivariate logistic regression analysis, dysphagia remained an independent predictor of poor outcomes in both females (OR: 23.4, 95% CI: 2.521-217.2, p=0.006) and males (OR: 15.769, 95% CI:1.686-147.509, p=0.016).

**Table 2: Comparison between patients with poor outcome at discharge, and patients with good outcome at discharge among females and males regarding baseline and clinical characteristics**

| Characteristic | Females (n=56) | | | | | Males (n=60) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Good Outcome (discharge mRS ≤ 2) | | Poor Outcome (discharge mRS ≥ 3) | | P value | Good Outcome (discharge mRS ≤ 2) | | Poor Outcome (discharge mRS ≥ 3) | | P value |
| | (n=7) | | (n=49) | | | (n=6) | | (n=54) | | |
| | 12.50% | | 87.50% | | | 10.00% | | 90.00 % | | |
| Age, median (range) | 47 (40-70) | | 64 (38-88) | | 0.016** | 64 (53-75) | | 60 (32-83) | | 0.405 |
| Hypertension, no. (%) | 4 | 57.1 % | 38 | 77.6 % | 0.35 | 2 | 33.3 % | 33 | 61.1% | 0.223 |
| Diabetes mellitus, no. (%) | 1 | 14.3 % | 25 | 51.0 % | 0.108 | 3 | 50.0 % | 18 | 33.3% | 0.655 |
| Coronary artery disease, no. (%) | 2 | 28.6 % | 14 | 28.6 % | 1 | 2 | 33.3 % | 17 | 31.5% | 1 |
| AF, no. (%) | 2 | 28.6 % | 16 | 32.7 % | 1 | 0 | 0.0 % | 9 | 16.7% | 0.578 |
| Body Mass Index > 30 kg/m2, no. (%) | 6 | 85.7 % | 39 | 79.6 % | 0.339 | 6 | 100.0% | 34 | 63.0% | 0.165 |
| Peripheral vascular disease, no. (%) | 0 | 0.0% | 1 | 2.0 % | 1 | 0 | 0.0 % | 3 | 5.6 % | 1 |
| Metabolic syndrome, no. (%) | 1 | 14.3 % | 23 | 46.9 % | 0.219 | 2 | 33.3 % | 14 | 25.9% | 0.653 |
| Previous stroke or previous TIA, no. (%) | 1 | 14.3 % | 15 | 30.6 % | 0.66 | 2 | 33.3 % | 16 | 29.6% | 1 |
| Family history of stroke, no. (%) | 0 | 0.0% | 6 | 12.2 % | 1 | 1 | 16.7 % | 6 | 11.1% | 0.541 |
| Smoking history, no. (%) | 1 | 14.3 % | 3 | 6.1 % | 0.423 | 4 | 66.7 % | 38 | 70.4% | 1 |
| Ischemic stroke | 5 | 71.4 % | 40 | 81.6 % | 0.614 | 6 | 100.0% | 38 | 70.4% | 0.868 |
| Hemorrhagic stroke | 2 | 28.6 % | 9 | 18.4 % | 0.614 | 0 | 0.0 % | 16 | 29.6% | 0.179 |
| NIHSS admission, median (IQR) | 7 | (6-7) | 15 | (11-18) | 0.001** | 6 | (5-7) | 13 | (8-17) | 0.003** |
| Dysphagia | 1 | 14.3 % | 39 | 79.6 % | 0.001** | 1 | 16.7 % | 41 | 75.9% | 0.008** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Time from onset to arrival (hours), median (IQR)** | | 4.5 | (3.5-7.5) | 5 | (3-8) | 0.884 | 6 | (3.5-10) | 5 | (3-7) | 0.492 |
| **Received IV or IA thrombolysis, no. (%)** | | 3 | 42.9% | 17 | 34.7% | 0.691 | 2 | 33.3% | 11 | 20.4% | 0.602 |
| **Thrombolysis related adverse events** | | 0 | 0.0% | 9 | 18.4% | 0.583 | 0 | 0.0% | 6 | 11.1% | 1 |
| **Oxfordshire stroke classification** | **TACS, no. (%)** | 1 | 20.0% | 7 | 17.5% | 1 | 0 | 0.0% | 4 | 10.5% | 0.369 |
| | **PACS, no. (%)** | 3 | 60.0% | 26 | 65.0% | | 5 | 83.3% | 20 | 52.6% | |
| | **POCS, no. (%)** | 1 | 20.0% | 6 | 15.0% | | 0 | 0.0% | 11 | 28.9% | |
| | **LACS, no. (%)** | 0 | 0.0% | 1 | 2.5% | | 1 | 16.7% | 3 | 7.9% | |
| **Presumed stroke etiology (TOAST)** | **large artery atherosclerosis, no. (%)** | 1 | 20.0% | 24 | 60.0% | 0.096 | 2 | 33.3% | 18 | 47.4% | 0.868 |
| | **cardioembolic, no. (%)** | 2 | 40.0% | 11 | 27.5% | | 3 | 50.0% | 11 | 28.9% | |
| | **small vessel disease, no. (%)** | 2 | 40.0% | 3 | 7.5% | | 1 | 16.7% | 8 | 21.1% | |
| | **other determined etiology, no. (%)** | 0 | 0.0% | 2 | 5.0% | | 0 | 0.0% | 0 | 0.0% | |
| | **cryptogenic/other non-determined etiology, no. (%)** | 0 | 0.0% | 0 | 0.0% | | 0 | 0.0% | 1 | 2.6% | |
| **Length of hospital stay in days, median (IQR)** | | 8 | (6.5-10.5) | 14 | (11-22) | 0.052 | 7.5 | (6-9) | 11 | (9-16) | 0.04** |

mRS: modified Rankin Scale, AF: Atrial Fibrillation; TIA: Transient Ischemic Attack; NIHSS: National Institutes of Health Stroke Scale; IQR: interquartile range; TACS: Total Anterior Circulation Stroke; PACS: Partial Anterior Circulation Stroke; POCS: Posterior Circulation Stroke; LACS: Lacunar Stroke; TOAST: Trial of ORG 10172 in Acute Stroke Treatment.

## DISCUSSION

In this pilot study, we observed that atrial fibrillation and obesity were more prevalent in female stroke patients, while a history of smoking was more common among male stroke patients. Previous research has reported a similar trend, highlighting a higher incidence of atrial fibrillation and a stronger association with obesity in female stroke patients, along with a less frequent smoking history compared to their male counterparts.[3,5-8,16]

Our results indicated that female stroke patients had higher levels of total cholesterol and triglycerides, along with lower uric acid levels compared to their male counterparts. These findings align with existing literature suggesting that females are less likely to achieve cholesterol targets, even with statin use, and are more likely to have lower uric acid levels than males.[17,18] However, previous stroke cohorts showed no gender-based differences regarding lipid profile[16,19.] Despite being statistically insignificant, our study showed higher prevalence of hypertension and metabolic syndrome in females that aligns with previous studies.[7,8,20] Additionally, our study females had longer duration of hospital stay, without reaching statistical significance. In contrast, data from Sweden suggest that females have shorter hospital length of stay than males.[21] This discrepancy underscores the significance of gender-related sociocultural factors, which can vary significantly across different sociocultural contexts worldwide.

Our study did not identify any gender-based differences in baseline and clinical characteristics, including age, diabetes mellitus, coronary artery disease, peripheral vascular disease, previous stroke or transient ischemic attack (TIA), family history of stroke, migraine, stroke symptomatology, stroke severity, or presumed stroke etiology. These findings contrast with previous reports that have noted gender-based differences in stroke risk factors and presentation.[2,3,9,22]

Our study found no gender disparities in the time from stroke onset to hospital arrival, the percentage of patients receiving acute thrombolysis, or the incidence of thrombolysis-related adverse events. A similar finding was reported in a previous registry-based study of Egyptian stroke patients.[8] However, this finding contrasts with previous studies conducted in Europe and the US, which have reported gender disparities in acute stroke management, particularly in the rates of acute thrombolysis.[23,24] Social network, and family caregiver availability may allow early recognition of stroke symptoms in elderly females.

Our study found no statistically significant differences in functional outcomes at discharge based on gender. However, more males achieved good functional outcomes at the 90-day follow-up, although this difference did not reach statistical significance. A previous study of stroke outcomes among Egyptian stroke patients showed no significant differences in stroke outcomes between both sexes.[7] In contrast, other studies reported worse outcomes among Egyptian women with acute stroke.[5,8] One possible explanation for this discrepancy is that gender-related biases may influence how outcomes are reported; for instance, patients might underestimate or overestimate their abilities based on their gender. Another possible explanation could be differences in baseline premorbid status.

Using logistic regression analysis, our study identified dysphagia as a significant independent predictor of poor outcomes for both males and females. This finding contributes to the increasing evidence highlighting the importance of early dysphagia screening and management in all acute stroke patients, regardless of gender. Current guidelines recommend that acute stroke patients be screened for dysphagia as soon as possible after hospital admission.[25] Swallowing difficulties can greatly affect patient recovery, outcomes, and overall quality of life.

Our study has several limitations that should be considered when interpreting the results. The primary limitation of our short-term pilot feasibility study is the small sample size, which may limit statistical power and prevent the identification of statistically significant gender-based differences. Additionally, recruitment of patients occurred during the COVID-19 pandemic, which further restricted the number of participants. Acute stroke patients with a confirmed COVID-19 diagnosis were not admitted to our stroke unit; instead, they were directed to specialized isolation centers in accordance with local hospital policies. Finally, we did not employ advanced investigations to gain a better understanding of stroke pathophysiology and the associated gender-based differences.

## CONCLUSION

This pilot study highlights important gender differences in stroke charachteristics and emphasizes the need for a wide-scale stroke registry in Egypt. Our results indicate the importance of targeted screening and stroke prevention strategies. Specifically, atrial fibrillation and lipid panel screening may be crucial strategies for primary stroke prevention among Egyptian women. The strong association between dysphagia and poor outcomes in both genders highlights the importance of early dysphagia screening and management in acute stroke care.

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Authors' contribution:
**Ahmed Abualhasan:** Concept, Data collection, manuscript writing
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All the authors have approved the final version to be published and agree to be accountable for all aspects of the work.